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FULL CONTENTS CLAIM + DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

Notes:
1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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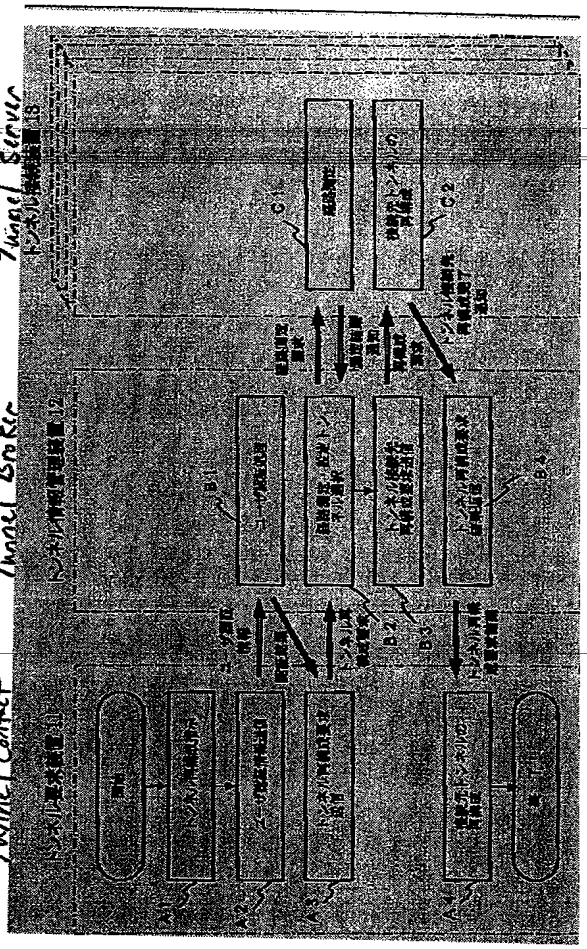
Dictionary: Last updated 03/23/2009 / Priority: 1. Information communication technology (ICT) / 2. Electronic engineering

CLAIM + DETAILED DESCRIPTION

[Claim(s)]
[Claim 1]It is in the 2nd network of a protocol which coexists with the 1st network and is different from said 1st network characterized by comprising the following. A packet correspondence procedure which carries out routing of the tunnel course which depends on encapsulation which suits a protocol of said 1st network to said communication packet when it is required that a communication packet should go via said 1st network to said 1st network, and transmits said communication packet.
An operating condition accumulation step which accumulates an operating condition of a tunnel course specified beforehand about two or more destination hosts

Drawing selection

Representative drawi



[Translation done.]

who cross said 1st network and exist from a transmission source host.
A reconstruction demand detecting step which detects a reconstruction demand of a tunnel course for a communication packet of the going direction from said transmission source host at least.
A communication quality measurement step which measures communication quality about a candidate of two or more of said tunnel courses specified beforehand according to said detected reconstruction demand.
A tunnel route determination step which determines one or more tunnel courses based on said measured communication quality and/or said accumulated operating condition, and a course resetting execution step which matches said one or more determined tunnel courses with a communication packet of said going direction, and resets them.

[Claim 2]The packet correspondence procedure according to claim 1, wherein it matches said course resetting execution step with a communication packet of a return direction to said transmission source host from said destination host in response to a communication packet of said going direction further and it resets said one or more determined tunnel courses.
[Claim 3]The packet correspondence procedure according to claim 1, wherein said communication quality measurement step measures transmission delay time of said communication packet, a hop number, and/or a zone as an index which gives said communication quality.
[Claim 4]The packet correspondence procedure according to claim 1 determining said tunnel route determination step as a tunnel course predicted that a communication packet is transmitted within an acceptable value of average transmission specified beforehand.
[Claim 5]The correspondence procedure according to claim 1, wherein said reconstruction demand detecting step supervises a reconstruction cycle or reconstruction marginal type traffic and detects said reconstruction demand at the time of an employment person's directions and a reconstruction opening day.
[Claim 6]The correspondence procedure according to claim 1, wherein said communication quality measurement step measures communication quality based on said accumulated operating condition.

[Claim 7]The correspondence procedure according to claim 1 or 6, wherein said communication quality measurement step measures communication quality about two or more destination hosts of a range beforehand defined as an evaluation object address.
[Claim 8]A packet correspondence procedure of any 1 description of Claims 1-7, wherein said 1st network is the version 4 of IP (Internet Protocol) and said 2nd network is the version 6 of IP.

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to a packet correspondence procedure.
[0002]
[Description of the Prior Art]The method of using tunneling art is one of the methods of performing the packet telecommunication between the hosts contained in this different-species network ranging over this base network under the environment where this base network is dotted with two or more different-species networks according to a different protocol from a base network. Tunneling is transmitting the original information on another architecture by encapsulating the information on a certain protocol inside the frame of another architecture, or a packet.
[0003][correspondence procedure / using tunneling art] In RFC3053 "IPv6 Tunnel Broker", it is especially indicated by RFC (Request For Comment) which is a document about IP (Internet Protocol) standard protocol. This literature is premised on the transitional situation at the time of an IP protocol shifting to the version 6 (the following v6 and notation) from the version 4 (the following v4 and notation). In this situation, an IPv6 network is just assumed to be dotted like scattering clouds all over the IPv4 network which is a base network.
[0004]The composition which RFC3053 "IPv6 Tunnel Broker" indicates consists of three network nodes, a tunnel client, a tunnel broker, and a tunnel server. A tunnel client exists in the boundary of an IPv6 network and IPv4 network including the transmission source host of an IPv6 packet, and is a tunnel connection former node corresponding to the protocol of both IPv4 and IPv6. A tunnel server exists in the boundary of this IPv4 network and an IPv6 network

including the final destination host of an IPv6 packet, and is a tunnel connection destination node corresponding to the protocol of both IPv4 and IPv6. A tunnel broker collaborates with a tunnel server, manages the tunnel initial entry between a tunnel client and a tunnel server, and controls a setup of a tunnel, change, and deletion. It is supposed that the tunnel course on the IPv4 network which connects the IPv6 network comrade with whom it is dotted by these is provided.

[0005]However, it is expected only with this composition that it cannot conform to the network environment to change and a network user cannot be provided with the optimal tunnel. The network node which constitutes the Internet is expanded by an addition or change of new connection equipment every day.

In the stage transitorium of IPv6, it is especially thought that change of this network resource is remarkable and the course which gives the optimal communication quality among the hosts disconnected via IPv4 network which needs a tunnel also carries out an interdiurnal change.

[change / according to people's social information needs / the traffic through the Internet by many users / every day] It is expected like the conventional method that the optimal routing cannot be provided depending on the method of appearing, and not respecting the network resource environment at the time or a network operating condition, but setting up a tunnel mechanically.

[0006]Although it is also a method surely to ask the employment person of a tunnel client for routing by manual operation based on change of the resource environment of these networks, great operation cost is assumed and it is not realistic.

[0007]

[Problem to be solved by the invention]In light of the above-mentioned problems, this invention is providing the packet telecommunication through the tunnel course reconstructed the best for a user, the purpose of this invention conforming to change of network resource environment which carries out an interdiurnal change, and attaining an employment person's laborsaving.

[0008]

[Means for solving problem]The packet correspondence procedure by this invention is provided with the following. It is in the 2nd network of a protocol which coexists with the

1st network and is different from this 1st network, When it is required that a communication packet should go via this 1st network, It is a packet correspondence procedure which carries out routing of the tunnel course which depends on the encapsulation which suits the protocol of this 1st network to this communication packet to this 1st network, and transmits this communication packet, The operating condition accumulation step which accumulates the operating condition of the tunnel course specified beforehand about two or more destination hosts who cross this 1st network and exist from a transmission source host. The reconstruction demand detecting step which detects a reconstruction demand of the tunnel course for the communication packet of the going direction from this transmission source host at least.
The communication quality measurement step which measures communication quality about the candidate of two or more of these tunnel courses ** specified according to the detected this reconstruction demand, The tunnel route determination step which determines one or more tunnel courses based on the measured this communication quality and/or the accumulated this operating condition, and the course resetting execution step which matches these one or more determined tunnel courses with the communication packet of this going direction, and resets them.

[0009]
[Mode for carrying out the invention]The work example of this invention is described in detail with reference to attached Drawings. Drawing 1 is a work example of this invention, and shows each internal configuration of three devices which perform a packet correspondence procedure, i. e., a tunnel request device, a tunnel information controlling device, and a tunnel contact. Each device may be realized by the usual computer.
[0010][the tunnel client 11, i.e., a tunnel request device,]
The V4 packet transmission and reception part 101 for communicating by IPv4 packet through IPv4 connected network, The address conversion section 102 which changes conversion of the transmission source address of the going direction IPv6 packet, and the destination address of a return direction IPv6 packet, The capsule treating part 103 for encapsulating the going direction IPv6 packet to IPv4 packet, and taking out an IPv6 packet from return direction

IPv4 packet by capsule opening, The V6 path control section 104 which performs path control of the packet which reached from an IPv6 network using the V6 routing table 109, When considering tunnel reconstruction as the V6 packet transmission and reception part 105 for letting the connected IPv6 network pass and communicating by an IPv6 packet, in order to receive the user authentication of the tunnel information controlling device 12, The tunnel reconstruction demand transmission section 107 for requesting the user-authentication-information transmission section 106 for sending user authentication information, selection, and a tunnel setup of the tunnel contact 13 which turns into the tunnel information controlling device 12 with a tunnel connection destination in order to carry out tunnel reconstruction, The connecting agency tunnel reconstruction section 108 for reconstructing the tunnel of tunnel connection origin according to the information from the tunnel information controlling device 12, The V6 routing table 109 which accumulates the channel information of an IPv6 network, i.e., routing information, The tunnel operating condition accumulating part 110 which accumulates the situation of IPv4 packet sending out by tunneling, The tunnel reconstruction directions part 111 which manages the tunnel reconstruction indicative data which the employment person of the tunnel request device 11 inputted, and makes a series of tunnel reconstruction processings start based on this information, It is ** constituted with the system time attaching part 112 which minces the time of the present system, and provides current time when required, and the IPv4 tunnel interface information 113.

[0011] the tunnel broker 12, i.e., a tunnel information controlling device,] The V4 packet transmission and reception part 201 for letting IPv4 connected network pass and communicating by IPv4 packet, The user authentication treating part 202 for verifying the user authentication information from the tunnel request device 11, The tunnel connection destination information storage part 203 which is a pool of the address prefix which can be assigned about the tunnel contact 13 which is an administration object, and accumulates the quota state of an address prefix, Course measurement / setting tunnel selecting part 204 which chooses the tunnel which should request course measurement to two or more tunnel contacts 13 to manage, and should be set additionally from those results to the

tunnel reconstruction demand from the tunnel request device 11, As opposed to the tunnel contact 13 of the tunnel which course measurement / setting tunnel selecting part 204 chose, The tunnel connection destination reconstruction demand transmission section 205 for sending the reconstruction demand of a tunnel connection destination, It is ** constituted with the tunnel reconstruction request result reply part 206 which returns the result which receives the tunnel reconstruction demand from the tunnel request device 11, and the V6 packet transmission and reception part 207 for letting the connected IPv6 network pass and communicating by an IPv6 packet. The V6 packet transmission and reception part 207 is needed when between the tunnel information controlling device 12 and the tunnel contacts 13 is an IPv6 network course.

[0012][the tunnel server 13, i.e., a tunnel contact,] The V4 packet transmission and reception part 301 for letting IPv4 connected network pass and communicating by IPv4 packet, The capsule treating part 302 for taking out an IPv6 packet from going direction IPv4 packet by capsule opening, and encapsulating a return direction IPv6 packet to IPv4 packet, The V6 path control section 303 which performs path control of the packet which reached from an IPv6 network using the V6 routing table 307, [the V6 packet transmission and reception part 304 and the demand from the tunnel information controlling device 12 for letting the connected IPv6 network pass and communicating by an IPv6 packet] The course measurement part 305 which measures the quality in the course between the tunnel request device 11 and the tunnel contact 13 concerned and between the tunnel contact 13 concerned and destination host, The connection destination tunnel reconstruction section 306 for reconstructing the tunnel of a tunnel connection destination according to the information from the tunnel information controlling device 12, It is ** constituted with the V6 routing table 307 which accumulates the channel information of an IPv6 network, i.e., routing information, and the IPv4 tunnel interface information 308.

[0013]Drawing 2 shows the method of the packet telecommunication via the usual tunnel course which each device shown in drawing 1 collaborates and performs. As shown in drawing 2, when there are IPv6 networkA and the IPv6 existing Internet isolated in IPv4 network, The communication to the destination host H2 of IPv6 in the

IPv6 Internet which is existing from the transmission source host H1 of IPv6 in IPv6 network A is realizable by using the tunnel on IPv4. IPv4 network said here is a network which communicates by Internet protocol IPv4, and an IPv6 network is a network which communicates by Internet protocol IPv6.

[0014]First, the going direction IPv6 packet to the IPv6 destination host H2 seen out from the transmission source host H1 goes via IPv6 network A, If the tunnel request device 11 which is tunnel connection origin is reached, the tunnel request device 11 encapsulates an IPv6 packet to IPv4 packet, and sends it out to IPv4 network. This encapsulation is realized by adding IPv4 header to this IPv6 packet, and making it IPv4 packet. At this time, the IPv four address of the tunnel contact 13 is set to a destination address of IPv4 header, and the IPv four address of the tunnel request device 11 is set to a transmission source address, respectively. A sending-out situation of IPv4 packet by this tunneling is always recorded.

[0015]Next, if this IPv4 packet reaches the tunnel contact 13 which is a tunnel connection destination, the tunnel contact 13 takes out an IPv6 packet from IPv4 packet by capsule opening, and sends out that IPv6 packet to the IPv6 Internet. This capsule opening removes IPv4 header of IPv4 packet, and is realized by returning to the original IPv6 packet. Communication to the destination host H2 from the transmission source host H1 is attained because this sent-out IPv6 packet reaches the destination host H2 via the IPv6 Internet.

[0016]If the return direction IPv6 packet to the destination host H1 seen out from the transmission source host H2 on the contrary on the other hand reaches the tunnel contact 13, it will be encapsulated by IPv4 packet like the case of the going direction packet, and will be sent out to IPv4 network. And if this reaches the tunnel request device 11, it will be returned to an IPv6 packet by capsule opening like the case of the going direction packet, and communication of the return direction from the transmission source host H2 to the destination host H1 is attained by it being sent to the destination host H2.

[0017]This invention is carried out based on the tunnel operating condition data till then, not only the above-mentioned usual tunneling processing but when the conditions beforehand specified by the employment person

of the tunnel request device 11 are satisfied further, The tunnel request device 11 is interlocked with the tunnel information controlling device 12 and two or more tunnel contacts 13 which the tunnel information controlling device 12 manages via IPv4 network, and is reconstructed in the optimal tunnel setup. An IPv6 network course may be sufficient between the tunnel information controlling device 12 and the tunnel contact 13.

[0018]Drawing 3 shows the usual tunneling procedure. The tunnel request device 11 processes according to the receipt of the IPv6 packet of the going direction from the transmission source host H1 who went via the V6 network A. Specifically, 104VV6 path-control-section 6 path control of the tunnel request device 11 is performed first (Step S11). Namely, if an IPv6 packet is received by the V6 packet transmission and reception part 105, The prefix of the destination address of the IPv6 packet thought to be the address prefix and address prefix length of each class of data who constitute the V6 routing table 109 mentioned later is compared, and a group in agreement is detected. In detection by this comparison, one biggest address prefix of address prefix length is adopted among groups in agreement. As for one, the group whose address prefix length corresponds with the prefix of the destination address of the received IPv6 packet since the group of the default root of 0 is also set up will certainly exist in the 11Vtunnel request device 6 routing table 109.

[0019]Drawing 4 shows the example of composition of the V6 routing table 109. As for the V6 routing table 109, corresponding to each course, 1 set of channel information (the group of data is called hereafter) is set to a line writing direction. [the group of the data of the V6 routing table 109] The address prefix length whose value in the case of a default route it is the effective length (bit length) of the address prefix which is a prefix of a destination address, and the prefix of a destination address, and is 0, It consists of an interface Type etc. which are Types of a network interface or an IPv4 tunnel interface.

[0020]Next, the tunnel request device 11 checks that the interface Type of the group detected in comparison with this V6 routing table 109 is a tunnel interface of IPv4, and performs address conversion (Step S12). The address conversion section 102 of the tunnel request device 11 changes the transmission source address of the received

IPv6 packet. This address conversion means making routing of a return direction packet possible, and changes it into a certain address in the IPv6 address space assigned to the network where the tunnel connection destination 13 which uses the transmission source address of an IPv6 packet belongs. Therefore, for example, modification of NAT (Network Address Translator) which replaces IPv6 transmission source address using the prefix according to IPv6 destination address is used. "RFC2663 IP Network Address Translator (NAT) Terminology and Considerations" is referred to for general NAT.

[0021]Next, the address conversion section 102 refers to the IPv4 tunnel interface information 113 by using as a key a value of an interface Type of a group detected by comparison of the front step S11, A quota prefix and quota prefix length are extracted, and if the assigned IPv6 address which carries out quota prefix correspondence already exists, for example in an address buffer pool etc. and it does not exist the assigned IPv6 address, it newly assigns, and it obtains an IPv6 address. And a transmission source address of an IPv6 packet received with this IPv6 address that came to hand is replaced.

[0022]Here, reference of drawing 5 shows an example of the IPv4 tunnel interface information 113. [a group of data which constitutes IPv4 tunnel interface information] An interface Type, a quota prefix, and quota prefix length, A self-tunnel address which is the IPv four address of the tunnel request device 11 which becomes tunnel connection origin, A partner tunnel address which is the IPv four address of the tunnel contact 13 used as a tunnel connection destination, the last use time which is the time which uses an applicable IPv4 tunnel interface at the end, and **, ** and others

[0023]If drawing 3 is referred to again, further, if needed, the tunnel request device 11 will recalculate the header checksum of TCP, UDP, and ICMP related to conversion of a transmission source address, etc., and will make the change. Next, the tunnel request device 11 performs encapsulation and packet sending out (Step S13). The capsule treating part 103 of the tunnel request device 11 encapsulates the IPv6 packet after address conversion, and performs creation and accumulation of tunnel operating condition data about IPv4 packet to send out. Then, total traffic is counted up and it transmits by the V4 packet

transmission and reception part 101 towards the tunnel contact 13. Here, in the capsule treating part 103, as it is shown in drawing 6, IPv4 header is added before an IPv6 packet, and let an IPv6 packet be IPv4 packet. The transmission source address of IPv4 header to add sets a partner tunnel address to the self-tunnel address of the group which came to hand with reference to IPv4 tunnel interface information by using as a key the value of the interface Type detected at Step S12, and a destination address, respectively. The date time second acquired by the system time attaching part 112 is set to the last use time of the IPv4 tunnel interface information referred to.

[0024]Here, the tunnel request device 11 stores the data about the operating condition of IPv4 packet to send out to the tunnel operating condition accumulating part 110 as creation and accumulation of tunnel operating condition data. This operating condition data may be created for every packet to send out, or may total and create IPv4 packet length per IPv6 destination address according to the embodiment of the reference period of reconstruction timing or tunnel operating condition data for every tunnel operating condition data acquisition time of a certain time interval. The tunnel operating condition data acquisition time which is the date time which this operating condition data acquired by the system time attaching part 112 at the time of tunnel operating condition data creation, IPv6 destination address, IPv4 packet length or its total value, and **, ** and others

[0025]Next, if IPv4 packet of the going direction reaches the tunnel contact 13, the tunnel contact 13 will process IPv4 packet. Specifically, the tunnel contact 13 performs capsule opening and packet sending out first (Step S21). The capsule treating part 302 of the tunnel contact 13 will process IPv4 packet, if IPv4 packet is received from IPv4 network by the V4 packet transmission and reception part 301. That is, the capsule treating part 302 is compounded to the IPv4 original packet, when IPv4 packet is divided. And IPv4 packet is checked using the IPv4 tunnel interface information 308.

[0026]Drawing 7 shows the example of the IPv4 tunnel interface information 308. The group of the data which constitutes the IPv4 tunnel interface information 308 is provided with the following.

Interface Type.

The self-tunnel address which is the IPv four address of the tunnel contact 13 used as a tunnel connection destination.

The partner tunnel address which is the IPv four address of the tunnel request device 11 which becomes tunnel connection origin.
The check of IPv4 packet using the IPv4 tunnel interface information 308 confirms that a group equivalent to the transmission source address of IPv4 received packet exists in the partner tunnel address of IPv4 tunnel interface information. The packet is discarded when it does not exist. Subsequently, by removing IPv4 header, the IPv6 packet of deed origin is obtained for capsule opening, and the V6 packet transmission and reception part 304 sends out the IPv6 packet to an IPv6 network.
[0027]If drawing 3 is referred to again next, the tunnel contact 13 will process according to the receipt of the IPv6 packet of the return direction which went via the IPv6 Internet to the transmission source host H1 in the going direction. Specifically, the tunnel contact 13 performs V6 path control first (Step S31). The 13Vtunnel contact 6 path control section 303 processes an IPv6 packet. Namely, if an IPv6 packet is received by the V6 packet transmission and reception part 304, [the V6 path control section 303] The prefix of the destination address of the IPv6 packet thought to be the address prefix and address prefix length of each class of data who constitute the V6 routing table 307 is compared, and a group in agreement is detected. In detection by this comparison, one biggest address prefix of address prefix length is adopted among groups in agreement. The composition of the data of the V6 routing table 307 is equivalent to the V6 routing table 109. Drawing 9 shows the example of composition of this V6 routing table 307.
[0028]Next, in detection by comparison with this V6 routing table 307, the tunnel contact 13 checks that an interface Type of a detected group is a tunnel interface of IPv4, and performs encapsulation and packet sending out (Step S32). Here, the capsule treating part 302 of the tunnel contact 13 encapsulates a received IPv6 packet, and transmits by the V4 packet transmission and reception part 301 towards the tunnel request device 11. In the capsule treating part 302, IPv4 header is added before an IPv6 packet like Step S13, and let an IPv6 packet be IPv4 packet. A transmission source address of IPv4 header to add sets a partner tunnel address to a self-tunnel address of a group which came to hand with reference to IPv4 tunnel interface information by

using as a key a value of an interface Type detected at Step S31, and a destination address, respectively.

[0029]On the other hand, if IPv4 packet of a return direction reaches the tunnel request device 11, the tunnel request device 11 will process IPv4 packet. Specifically, the tunnel request device 11 performs capsule opening first (Step S41). Here, the capsule treating part 103 of the tunnel request device 11 processes IPv4 packet for IPv4 packet according to a receipt from IPv4 network by the V4 packet transmission and reception part 101. That is, the capsule treating part 103 is compounded to the IPv4 original packet, when IPv4 packet is divided. IPv4 packet is checked using the IPv4 tunnel interface information 113. A check of IPv4 packet using the IPv4 tunnel interface information 113 confirms that a group equivalent to a transmission source address of IPv4 received packet exists in a partner tunnel address of the IPv4 tunnel interface information 113. The packet is discarded when it does not exist. Subsequently, an IPv6 packet of deed origin is obtained for capsule opening like Step S21 by removing IPv4 header.

[0030]next, the tunnel request device 11 -- address conversion -- and packet sending out is carried out (Step S42). The address conversion section 102 of the tunnel request device 11 processes an IPv6 packet obtained at the front step S41. That is, the address conversion section 102 is changed into a value of a transmission source address of the going direction packet which corresponds a destination address of an IPv6 packet obtained at the front step S41 by referring to an address buffer pool based on the destination address, for example. Then, if needed, a header checksum of TCP, UDP, and ICMP related to conversion of a destination address, etc. are recalculated, and the change is made. Subsequently, the V6 packet transmission and reception part 105 sends out the IPv6 packet to an IPv6 network.

[0031]Drawing 10 shows procedure of reconstruction processing of an automatic tunnel. It is made timing which agreed on conditions beforehand specified by employment person of the tunnel request device 11 in tunnel reconstruction processing based on the tunnel operating condition data till then, The tunnel request device 11 interlocks via two or more tunnel contacts 13 which the tunnel information controlling device 12 and the tunnel information controlling device 12 manage, and IPv4 network, and it enables it to reconstruct it in the optimal

tunnel setup. An IPv6 network course may be sufficient between the tunnel information controlling device 12 and the tunnel contact 13. In this case, the tunnel information controlling device 12 and the tunnel contact 13 communicate instead of V4 packet transmission and reception part using V6 packet transmission and reception part, respectively. Henceforth, a case only via IPv4 network is explained.

[0032]The tunnel request device 11 starts the reconstruction processing of a tunnel to the timing corresponding to the conditions specifically first specified beforehand by the employment person of the tunnel request device 11 as shown in drawing 10 (Step A1). Subsequently, the tunnel request device 11 receives attestation of being an authorized user in the tunnel information controlling device 12 (Step A2 and Step B1), creates a tunnel reconstruction demand based on the tunnel operating condition data till then, and sends it to the tunnel information controlling device 12 (step A3). The tunnel information controlling device 12 cooperates with two or more tunnel contacts 13 of the administration object range, chooses the tunnel which should be set up measurement of a selectable course, and based on the result (step B-2 and Step C1), and reconstructs a connection destination tunnel (Step B3 and Step C2). Then, the tunnel reconstruction request result which is information required for reconstruction of tunnel connection origin is replied to the tunnel request device 11 (step B4). Finally the tunnel request device 11 reconstructs a connecting agency tunnel based on this received tunnel reconstruction request result (step A4).

[0033]Although the quota prefix used for conversion of the transmission source address of the IPv6 packet of the going direction assigns and uses what is beforehand set to the tunnel connection destination information storage part 203 of the tunnel information controlling device 12 in the method explained henceforth, Unlike this method, each tunnel contact 13 manages, without managing a quota prefix with the tunnel information controlling device 12, The tunnel contact 13 assigns at the time of reconstruction of a connection destination tunnel of the above-mentioned step C2, and the embodiment referred to as including the quota prefix in a tunnel connection destination reconstruction completion notification, and returning to the tunnel information controlling device 12 is also considered.

[0034]If it is referred to for the tunnel request device 11 of drawing 10, the tunnel request device 11 will reconstruct an automatic tunnel. Specifically, the tunnel request device 11 performs tunnel reconstruction directions (Step A1). The tunnel reconstruction directions part 111 of the tunnel request device 11 has managed tunnel reconstruction indicative data, when it agrees on the conditions specified there, performs initialization processing and shifts to processing of the following step A2. The employment person of the tunnel request device 11 sets tunnel reconstruction indicative data separately beforehand. Tunnel reconstruction indicative data is provided with the following. For example, the time of a reconstruction opening day, a reconstruction cycle, or the reconstruction timing that is reconstruction marginal total traffic.
The reference period of the tunnel operating condition data which is indicative data of whether to refer to the tunnel operating condition data from before which period (date time) to the present at the time of tunnel reconstruction.
Address range for reconstruction which is indicative data of the range of the target address IPv6 address at the time of reconstruction.
This address range for reconstruction can consider the address IPv6 address maximum number and a total traffic ratio higher rank adoption limit. A total traffic ratio higher rank adoption limit is specification the address of what [top]% of the total traffic (for example, 80%) in tunnel operating condition data to make into the address IPv6 address for reconstruction. A judgment and initialization processing of designated condition agreement are performed as follows. When [namely,] the time of a reconstruction opening day and a reconstruction cycle are specified for example, When there is nothing between the past reconstruction start timing, i.e., the reconstruction start timing computed from the time of a reconstruction opening day, and a reconstruction cycle, that the time of a reconstruction enforcing date is the nearest, and the system time referred to from the system time attaching part 112, Tunnel reconstruction is started and system time is set as initialization processing at the time of a reconstruction enforcing date. On the other hand, when reconstruction marginal total traffic is specified and total traffic exceeds reconstruction marginal total traffic, tunnel reconstruction is started and total traffic is cleared to 0.

[0035]Next, the tunnel request device 11 transmits user authentication information (Step A2). The user-authentication-information transmission section 106 of the tunnel request device 11 transmits user authentication information to the tunnel information controlling device 12 in order to receive the user authentication of the tunnel information controlling device 12. That is, the user-authentication-information transmission section 106 has accumulated and managed user authentication information, and, specifically, the user-identification child (for example, use ID) who identifies a user, and the data for qualification attestation (for example, password) are contained in this user authentication information. The data for qualification attestation may be enciphered and stored. The user-authentication-information transmission section 106 takes out this accumulated user authentication information, and transmits to the tunnel information controlling device 12 by the V4 packet transmission and reception part 101. When the data for qualification attestation is enciphered and stored, it decodes and transmits as user authentication information.

[0036]Next, the tunnel request device 11 transmits a tunnel reconstruction demand (step A3). [the tunnel reconstruction demand transmission section 107 of the tunnel request device 11] When receiving the tunnel information controlling device utilization permission from the tunnel information controlling device 12 by the V4 packet transmission and reception part 101, It waits to lose a tunnel in use and the group of all the data of the IPv4 tunnel interface information 113 is deleted for all the channel information **** with the tunnel interface of IPv4 in the V6 routing table 109. Subsequently, a tunnel reconstruction demand is created and it is transmitted to the tunnel information controlling device 12 by the V4 packet transmission and reception part 101. For the check of the existence of a tunnel, it checks during use based on the difference of the last use time of the IPv4 tunnel interface information 113, and the current time obtained by the system time attaching part 112, for example. Here [including an address IPv6 address list and the IPv four address of the tunnel request device 11], [a tunnel reconstruction demand] It is aimed at the data of the range of a reference period specified with reconstruction indicative data from the tunnel operating condition data

stored in the tunnel operating condition accumulating part 110 if the preparation method of an address IPv6 address list is explained, Traffic (IPv4 packet length or its total value) is totaled for every thing of IPv6 destination address which has same top n bits, and the group of an IPv6 address and traffic is created. The bit (128-n) of the low rank of the IPv6 address of the group created at this time sets a suitable value, such as adopting what has the biggest traffic among the things of an IPv6 address which have same top n bits. Subsequently, those groups are aligned in order of ****** by using traffic as a key. The list of IPv6 addresses is further extracted and obtained from there according to specification of the address range for reconstruction of tunnel reconstruction indicative data. The value of the above-mentioned n can generally consider 48, 64, 96, etc. The embodiment which the employment person of the tunnel request device 11 other than the embodiment which makes the value of n a fixed value can specify separately beforehand is also considered. The IPv four address of the tunnel request device 11 is the IPv four address of the tunnel request device 11 under tunnel reconstruction processing.

[0037]Next, the tunnel request device 11 reconstructs a connecting agency tunnel (step A4). The connecting agency tunnel reconstruction section 108 of the tunnel request device 11 receives the tunnel reconstruction request result from the tunnel information controlling device 12 by the V4 packet transmission and reception part 101, and performs reconstruction of tunnel connection origin. Every IPv6 destination address of a tunnel reconstruction request result, the connecting agency tunnel reconstruction section 108 creates one group of new data to the V6 routing table 109 and IPv4 tunnel interface information, and adds it to them, respectively.

[0038]Here, explanation of the group of the data added to the V6 routing table 109 will set top n bits of the address IPv6 address of a tunnel setting request result to an address prefix. If all of top n bits of the address IPv6 address of a tunnel reconstruction request result value "0" Become, the value "0" will be set to address prefix length, otherwise, the value n will be set to him. The tunnel interface number of IPv4 is newly secured and set to an interface Type.

[0039]Explanation of the group of the data added to the IPv4 tunnel interface information 113 will set to an interface Type the tunnel interface number of IPv4 used for the

interface Type of processing to the V6 routing table 109 of the preceding clause. The quota prefix of a tunnel reconstruction request result is set to a quota prefix. The quota prefix of a tunnel reconstruction request result is set to quota prefix length. Its own [of the tunnel contact 11] IPv four address is set to a self-tunnel address. The connection destination tunnel address of a tunnel reconstruction request result is set to a partner tunnel address.

[0040]Above, automatic tunnel re-style processing is ended. If it is referred to for the tunnel information controlling device 12 of drawing 10, the tunnel information controlling device 12 will perform user authentication processing first according to the reconstruction demand of the tunnel from the tunnel request device 11 (Step B1). The user authentication treating part 202 of the tunnel information controlling device 12 performs authenticating processing of the user authentication information from the tunnel request device 11. That is, the user authentication treating part 202 receives user authentication information by the V4 packet transmission and reception part 201, and verifies the user authentication information using the user registration information which the user authentication treating part 202 holds. The user-identification child (for example, use ID) and the data for qualification attestation (for example, password) to the user whom the employment person of the tunnel information controlling device 12 permitted the use are contained in user registration information. The data for qualification attestation may be hash-ized (cancellation). In verification of user authentication information, the user authentication information corresponding to the user-identification child of user authentication information who received exists in user registration information, and it checks that each data for qualification attestation is in agreement. When the data for qualification attestation in user registration information is hash-ized, the data for qualification attestation of the received user authentication information is hash-ized, and it verifies using it. If there is no problem in a verification result, a tunnel information controlling device utilization permission will be transmitted to the tunnel request device 11 by the V4 packet transmission and reception part 201, and the processing state over the tunnel request device 11 concerned of the tunnel information controlling device 12 will be set to "logon" which receives all the processing demands. This processing

state is used for the judgment of being ** with a receptacle in it, when the tunnel information controlling device 12 receives the processing demand from the tunnel request device 11.

[0041]Next, the tunnel information controlling device 12 performs course measurement and setting tunnel selection (step B-2). Course measurement / setting tunnel selecting part 204 of the tunnel information controlling device 12 processes the tunnel reconstruction demand from the tunnel request device 11. Namely, when receiving the tunnel reconstruction demand from the tunnel request device 11 by the V4 packet transmission and reception part 201, [the tunnel contact 13] [as course measurement] Course measurement / setting tunnel selecting part 204 creates the course measurement request for requesting course measurement to two or more tunnel contacts 13 which are administration objects. A course measurement request is provided with the following.

It is data posted from a tunnel reconstruction demand, and is an address IPv6 address list.

The IPv four address of the tunnel request device 11.

It is good also as limiting the range of the evaluation object point by making an address IPv6 address into the address of the predetermined range beforehand. Limiting the range of the evaluation object point can expect derating to the network at the time of measurement, and the improvement in processing efficiency at the time of a setup.

[0042]Next, course measurement / setting tunnel selecting part 204 transmits the created course measurement request to two or more tunnel contacts 13 which are their administration objects by the V4 packet transmission and reception part 201. The tunnel contact 13 made into a transmission object is the tunnel contact 13 of all the kinds accumulated in the tunnel connection destination information storage part 203. The tunnel connection destination information storage part 203 is a pool of the address prefix which can be assigned about the tunnel contact 13 which is an administration object, and is also the information which shows the quota state of an address prefix. This tunnel connection destination information A connection destination tunnel address and the IPv four address of the tunnel contact 13, It is an implication about the quota prefix which is IPv6 prefix assigned to a tunnel connection former network, the quota prefix length who is

the effective length (bit length) of a quota prefix, and an assignment place. Data other than this assignment place is set beforehand. When an assignment place assigns a quota prefix to the tunnel request device 11 which becomes tunnel connection origin, the IPv four address of the tunnel request device 11 is set. In not assigning, value"0" is set, for example.

[0043]Subsequently, the tunnel information controlling device 12 chooses a setting tunnel. That is, course measurement / setting tunnel selecting part 204 receives the measurement result notice from the tunnel contact 13 by the V4 packet transmission and reception part 201. When the measurement result notice from all the tunnel contacts 13 of an administration object gathers, each course is evaluated based on those measurement results for every IPv6 address of an address IPv6 address list, and the tunnel which should newly be set up is chosen.

[0044]Drawing 11 explains the situation of selection of the tunnel contact 13 by the tunnel information controlling device 12. There are two courses, the course 1 and the course 2, which go via a tunnel which is different here when communicating from the tunnel request device 11 to the destination host H2, The time delay which is a measurement result about these two is compared, and the tunnel contact 13 13 of the smallest value, for example, the tunnel contact used for the course 1, is chosen. Selection of a default tunnel evaluates the measurement result between the tunnel request device 11 and the tunnel contact 13, and chooses the best tunnel contact 13.

[0045]If drawing 10 is referred to again, the tunnel information controlling device 12 will transmit a tunnel connection destination reconstruction demand next (Step B3). The tunnel connection destination reconstruction demand transmission section 205 of the tunnel information controlling device 12 transmits a tunnel connection destination reconstruction demand to the tunnel contact 13. That is, the tunnel connection destination reconstruction demand transmission section 205 cancels assignment of all the address prefixes about the tunnel request device 11 under tunnel reconstruction processing in the tunnel connection destination information storage part 203. Specifically, the assignment place in the tunnel connection destination information storage part 203 clears the assignment place of all the groups which are in agreement

with the tunnel request device 11 under reconstruction processing by un-assigning. To each tunnel contact 13 selected by step B-2, a tunnel connection destination reconstruction demand is created and it is transmitted to the tunnel contact 13 of each tunnel by the V4 packet transmission and reception part 201. When the data contained in a tunnel connection destination reconstruction demand is explained here, [a quota prefix] One of the quota prefixes concerned which are pooled by the tunnel connection destination information storage part 203 and which are turned tunnel contact 13 is newly assigned to the tunnel request device 11 under tunnel reconstruction processing, and the quota prefix is set. A connection destination tunnel address is specifically in agreement with the address of the tunnel contact 13 concerned in the tunnel connection destination information storage part 203, An assignment place chooses arbitrary one out of the group of the data which is un-assigning, and sets the IPv four address of the tunnel request device 11 under tunnel reconstruction processing to the assignment place of the group. And the quota prefix of the group is set to the quota prefix of a tunnel connection destination reconstruction demand. Quota prefix length sets the quota prefix length of the selected group who mentioned above. A connecting agency tunnel address sets the IPv four address of the tunnel request device 11 under tunnel reconstruction processing.

[0046]Next, the tunnel information controlling device 12 replies a tunnel reconstruction request result (step B4). The tunnel reconstruction request result reply part 206 of the tunnel information controlling device 12 transmits a tunnel reconstruction request result to the tunnel request device 11 in response to a tunnel connection destination reconstruction completion notification from all the tunnel contacts 13 which transmitted a tunnel connection destination reconstruction demand. If a tunnel connection destination reconstruction completion notification from all the tunnel contacts 13 which transmitted a tunnel connection destination reconstruction demand is received by the V4 packet transmission and reception part 201, Data required for tunnel reconstruction of tunnel connection origin is created as a tunnel reconstruction request result, and is transmitted to the tunnel request device 11 which had a tunnel reconstruction demand by the V4 packet transmission and reception part 201. This tunnel reconstruction request

result comprises data for every selected tunnel contact 13. If data contained every tunnel contact 13 is explained, an IPv6 address address list will extract and set IPv6 destination address which chose the tunnel contact 13 corresponding from an address IPv6 address list of course measurement requests of step B-2. A value "0" is set when the tunnel contact 13 corresponding as a default tunnel is chosen. A quota prefix sets a quota prefix of a tunnel connection destination reconstruction demand of Step B3. Quota prefix length sets quota prefix length of a tunnel connection destination reconstruction demand of Step B3. A connection destination tunnel address sets the IPv four address of the corresponding tunnel contact 13. A processing state over the tunnel request device 11 concerned of the tunnel information controlling device 12 is set to "log off" which receives only user authentication information.

[0047]If it is referred to for the tunnel contact 13 shown in drawing 10, the tunnel contact 13 will perform course measurement according to the course measurement request from the tunnel information controlling device 12 (Step C1). Specifically, the course measurement part 305 of the tunnel contact 13 processes the course measurement request from the tunnel information controlling device 12. That is, the course measurement part 305 will perform quality measurement of a course, if the course measurement request from the tunnel information controlling device 12 is received by the V4 packet transmission and reception part 301. Here, a measuring object course is between the tunnel request device 11 under tunnel reconstruction processing, and the tunnel contact 13 concerned, and between the tunnel contact 13 concerned and destination host's. The time base range of a course unites these two. That of the tunnel request device 11 and the tunnel contact 13 concerned, and in between, to an address IPv6 address list (plurality), since it is common, one measurement may be sufficient to not every address IPv6 address but an address list. The value of a course measurement request is used for the IPv four address of the tunnel request device 11, and a destination host's IPv6 address. That is, although a hop number, a time delay, a zone, etc. can be considered as measurement METORIKUSU to METORIKUSU used for measurement, the time delay usually used here is adopted. The measurement tool which cooperates with the tunnel information controlling device 12, and operates is used for a

measurement tool. For example, trace route (traceroute) and PICHA (pchar) which KAIDA (CAIDA:the CooperativeAssociation for Internet Data Analysis) provides are used as a tool. When you can reach from the tunnel contact 13 to neither the tunnel request device 11 nor the destination host H2, suppose a measurement result that the worst measurement result as attainment being impossible was obtained.

[0048]They are deleted when the information about the tunnel to the tunnel request device 11 under reconstruction processing is shown in the IPv4 tunnel interface information 308 and the V6 routing table 307. Subsequently, a measurement result is transmitted to the tunnel information controlling device 12 by the V4 packet transmission and reception part 301 as a measurement result notice next. Next, the tunnel contact 13 reconstructs a connection destination tunnel (Step C2). The connection destination tunnel reconstruction section 306 of the tunnel contact 13 processes the tunnel connection destination reconstruction demand from the tunnel information controlling device 12. That is, the tunnel connection destination reconstruction demand from the tunnel information controlling device 12 is received by the V4 packet transmission and reception part 301, and one group of new data is added to the V6 routing table 307 and IPv4 tunnel interface information, respectively. As a group of the data added to the V6 routing table 307, the quota prefix of a tunnel connection destination reconstruction demand is set to an address prefix. The quota prefix length of a tunnel connection destination reconstruction demand is set to address prefix length. The tunnel interface number of IPv4 is newly secured and set to an interface Type. The tunnel interface number of IPv4 equivalent to having set to the interface Type of processing to the V6 above-mentioned routing table 307 is set to an interface Type as a group of the data added to IPv4 tunnel interface information. Its, i.e., a tunnel contact, IPv four address is set to a self-tunnel address. [ress 13 who uses it for a tunnel connection destination] The connecting agency tunnel address of a tunnel connection destination reconstruction demand is set to a partner tunnel address.

[0049]Finally, the tunnel contact 13 creates a tunnel connection destination reconstruction completion notification, and transmits to the tunnel information controlling device 12 by the V4 packet transmission and

reception part 301. The 2nd work example is described. In the tunnel selection to the IPv6 destination host in which the 2nd work example has a specific employment person of the tunnel request device 11, Give priority not to a time delay but to other METORIKUSU (for example, bandwidth), and to make tunnel selection, [by specifying the METORIKUSU concerned as tunnel reconstruction indicative data additionally as priority METORIKUSU specification] It can make it possible to reconstruct in a tunnel setup which fulfills the route quality to demand.
[0050]The main changed parts for this are explained. Data is added to the tunnel reconstruction indicative data in tunnel reconstruction directions of Step A1. That is, as priority METORIKUSU specification, when specifying a zone as priority METORIKUSU, a "zone" is set to priority METORIKUSU, for example. The address IPv6 address (one or more) made applicable [of priority METORIKUSU] to use is set to the address IPv6 address list for priority METORIKUSU. The address prefix length in the case of setting the channel information to the address for priority METORIKUSU to the V6 routing table 109 is set to address prefix length. A bigger value than n explained by step A3 is set to address prefix length.
[0051]In tunnel reconstruction demand transmission of step A3, data is added to a tunnel reconstruction demand. That is, priority METORIKUSU specification of tunnel reconstruction indicative data is posted to priority METORIKUSU specification. Although processing equivalent to the usual address IPv6 address is performed also to priority METORIKUSU specification, [in reconstruction of a connecting agency tunnel of step A4] About address prefix length of a group of data added to the V6 routing table 109, address prefix length of priority METORIKUSU specification is used.
[0052]In course measurement of step B-2, and setting tunnel selection, data is added to a course measurement request of course measurement. That is, priority METORIKUSU specification of a tunnel reconstruction demand is posted to priority METORIKUSU specification. A disposal method of selection of a setting tunnel is changed. That is, to an address IPv6 address in an address IPv6 address list for priority METORIKUSU of priority METORIKUSU specification, a case of a best course, for example, a zone, chooses a course in which bandwidth is large, by

METORIKUSU specified by priority METORIKUSU.
[0053][course measurement to an address IPv6 address which is in an address IPv6 address list for priority METORIKUSU of priority METORIKUSU specification in course measurement in Step C1] A tool which measures quality specified as a measurement tool by priority METORIKUSU, for example, a tool which can perform measurement of bandwidth in the case of a zone, is used.
The 3rd work example is described.
[0054]In reconstruction of a tunnel setup of the automatic rebuilding type tunnel connected network device described in the 1st work example, In tunnel reconstruction indicative data, [the employment person of the tunnel request device 11] It can make it possible to reconstruct in a tunnel setup which fills specification of permission average transmission speed by specifying traffic additionally as permission average transmission speed per [which is permitted in the course between the tunnel request device 11 and the tunnel contact 13] unit time.
[0055]The main changed parts for this are explained. In tunnel reconstruction directions of Step A1, data is added to tunnel reconstruction indicative data. Namely, the indicative data for restricting the average transmission speed to permit to a connection destination tunnel and its permission average transmission speed is specified for every connection destination tunnel. That is, the IPy four address of the tunnel contact 13 which restricts the average transmission speed permitted to a connection destination tunnel is set. The permission average transmission speed to the connection destination tunnel applicable to the allowable traffic of a connection destination tunnel is set.
[0056]In tunnel reconstruction demand transmission of step A3, data is added to a tunnel reconstruction demand. That is, a connection destination tunnel and permission average transmission speed of tunnel reconstruction indicative data are posted to a connection destination tunnel and its permission average transmission speed. The average transmission speed track record corresponding to the address IPv6 address list of tunnel reconstruction demands is totaled and set to the average transmission speed performance list of an address IPv6 address from the tunnel operating condition data stored in the tunnel operating condition accumulating part 110, and its reference period.
[0057]In course measurement and setting tunnel selection in

step B-2, it changes as follows. Namely, in channel selection to each address IPv6 address of selection of a setting tunnel, a connection destination tunnel specified by tunnel reconstruction demand is received, Suppose that priority is given over a quality of a course by a measurement result, is given to the sum of an average transmission speed track record being settled in permission average transmission speed, and the tunnel contact 11 is chosen.

[0058]According to this example, by specification of reconstruction timing of tunnel reconstruction indicative data, tunnel reconstruction can be carried out for every fixed time, or it can carry out for every timing which reached fixed total traffic. By specification of the address range for reconstruction of tunnel reconstruction indicative data, it can be supposed whether to be the number of an address IPv6 address for reconstruction how many [top] with many traffic track records, and others can also be restricted to a form of using a default tunnel. Therefore, in consideration of operating environments, such as an employment situation of tunneling, and a user's needs, when an employment person of the tunnel request device 11 does suitable specification for this tunnel reconstruction indicative data, it can reconstruct in the optimal tunnel setup. Here, the optimal tunnel setup has good processing efficiency at the time of the usual tunneling processing, satisfies a user's demand, for example, there are few time delays and it means that processing efficiency is good at the time of tunnel reconstruction.

[0059][about communication by tunneling to the IPv6 destination host in the IPv6 Internet which is existing from the IPv6 transmission source host who is in the IPv6 network in the environment where an IPv6 network isolates and exists all over IPv4 network according to this example] When the tunnel is already set up and used, with the method proposed by this invention, It carries out based on the tunnel operating condition data till then for every timing corresponding to the conditions beforehand specified by the employment person of the tunnel request device 11, for example, fixed time, and every fixed accumulation traffic, The tunnel request device 11 interlocks via two or more tunnel contacts 13 which the tunnel information controlling device 12 and the tunnel information controlling device 12 manage, and IPv4 network, and can be reconstructed in the optimal tunnel setup. A general time delay by specification

of the employment person of the tunnel request device 11 to reconstruction by tunnel setup to which priority was given at this time In addition, the thing to reconstruct in a tunnel setup which gave priority to bandwidth, Or it can reconstruct so that it may become a tunnel setup below the value which specified the average transmission speed between the tunnel request device 11 and the tunnel contact 13.

[0060]The network topology which changes with days and months by this, communication quality, And the optimal tunnel setup according to the employment situation of tunneling, such as traffic and a communication destination, and the user's needs can be maintained, and communication by tunneling which is efficient as a whole and has little employment load for the employment person of the tunnel request device 11 is attained.

[0061]An IPv6 Internet course may be sufficient between the tunnel information controlling device and tunnel contact in this example. Although the environment at the time of the protocol of the Internet shifting to IPv6 from IPv4 was explained to this example as a premise, the packet correspondence procedure of this invention is not limited to this specific version. IP limitation of the network protocol is not carried out, but this invention can be applied also to various protocols.

[0062]

[Effect of the Invention]The packet telecommunication through the tunnel course reconstructed the best for a user can be provided conforming to change of the network resource environment and the utilization request which carry out an interdiurnal change, and attaining an employment person's laborsaving with the packet correspondence procedure by this invention.

[Translation done.]